

SPRING 2015 LAB DESCRIPTIONS

<u>Week #</u>	<u>Lab Title</u>	<u>Lab Description</u>
1	Pseudoscience	The lab starts as a discussion regarding what makes a fact a "scientific fact". Students will then need to go to a store and take a photo of a product in the store that claims to have scientific evidence backing its validity. Students will then evaluate if the product really is based on peer reviewed science.
2	DNA Modeling	Students will construct DNA models to understand DNA structure.
3	DNA to Protein	Students will work through a simulation illustrating DNA structure, DNA expression, and how mutations affect proteins. http://concord.org/stem-resources/dna-protein
4	Patterns of Inheritance & Meiosis	Students work through a great online simulation illustrating the connection between inheritance and meiosis. http://concord.org/stem-resources/modern-genetics
5	Darwin's Revolution in Thought	Students will watch a video by Stephen Gould that dispels some common misconceptions regarding evolutionary theory. They will then write a report regarding how these misconceptions have slowed acceptance of evolutionary thought in society.
6	Stickleback Evolution Lab	Student work through a case study illustrating the correlation of the physiology of this fish with it's fossil record. (http://media.hhmi.org/biointeractive/vlabs/stickleback/index.html)

7	Natural Selection Simulation	Students will work through a natural selection simulation. It beautifully illustrates how the environment can select for certain traits.
8	Microevolution as Changes in Allele Frequencies	Students can use black and white beans to simulate a population of organisms undergoing evolutionary change. Through this activity, students will see how natural selection and genetic drift change allele frequencies of populations.
9	Biogeography Case Study	Students will be presented with data on the natural history of lizards in the genus <i>Gallotia</i> . They will correlate geological, morphological, and molecular data to construct a phylogeny of this genus.
10	Caminalcule Phylogeny	Students will work through a case study of hypothetical "caminalcules" (from an NABT article). Based on the fossil evidence that is provided, students are to construct phylogenies based on this group's fossil record.
11	Fossil Correlations	Students will interpret geological data from digs across the world and identify correlations of fossils and then construct the evolutionary history of a taxonomic group of organisms.
12	Human evolution	Students will analyze the transitions of skull characteristics from ape-like to human-like in human ancestor skull models.
13	Intelligent Design on Trial	Students will watch this video and then discuss the scientific validity of the Intelligent Design movement.
14	Biological Evolution PPT	Students choose a topic that relates to society and biological evolution and create a PPT illustrating the impact of this topic upon modern society.

Patterns of Inheritance

Upon completion of this lab, students will be able to:

1. Describe how homologous genes interact to produce a phenotype.

Feel free to modify this document by typing your answers under the questions below. Upload your completed lab into the appropriate “Dropbox” in Cobra.

Visit the following website to access and run the “Modern Genetics” activity:

<http://concord.org/stem-resources/modern-genetics>

Click the “Download and Launch” button to begin the activity.

PART I: Intro and Rules

1. After the application loads, click the Intro and Rules tab on the left. Follow the directions and record your answers in the correct spaces below. I also have some additional questions that are not in the program.
2. After clicking on the “Breed offspring” buttons a few times each, what kind of trait do you think fancy tail is?
3. If two dragons have both have wings, what can you say about their offspring?
4. If one parent has wings, does that guarantee that the child will have wings?
5. Do you have an idea about how wings are inherited? What kind of trait do you think wings are?
6. Referring to the page where you can control and change the dragon’s alleles, which gene combinations yield a fancy tail? Which combinations yield wings?
7. Feel free to play with the other genes on the chromosomes. There is a combination that yields a dead dragon. Which is it?
8. Complete the table below.

	GENOTYPE/PHENOTYPE		
	Homozygous dominant	Heterozygous	Homozygous recessive
Horn gene			
Wing gene	<i>WW / no wings</i>	<i>Ww / no wings</i>	<i>ww / wings</i>
Leg gene			
Tail gene	<i>TT / fancy tail</i>	<i>Tt / fancy tail</i>	<i>tt / plain tail</i>
Fire gene			
Color 1 gene			
Color 2 gene			

9. In 50 – 100 words, describe how genes can interact with each other to effect the physical appearance of an organism.

PART II: Meiosis

10. Click on the “Meiosis” tab on the left.
11. You should now see the mother and father dragons. The cells with the chromosomes in them represent the cells in their reproductive organs that will undergo meiosis to become the sperm or egg.
12. Click the “play” button under each cell to watch it undergo meiosis.

13. Click the magnifying glass button under the cells to zoom and look at the chromosomes for the mother. You can then drag and drop the chromosomes to move them around so that you can make sense of what genes ended up in which cells. Do the same for the father.
14. What genotype/phenotype does the mother have for each gene? Complete the table.

Gene	Mother's Genotype / Phenotype
Horn gene	
Wing gene	<i>Ww / no wings</i>
Leg gene	
Tail gene	
Fire gene	
Color 1 gene	
Color 2 gene	

15. What genotype/phenotype does the father have to each gene? Complete the table.

Gene	Father's Genotype / Phenotype
Horn gene	
Wing gene	<i>ww / wings</i>
Leg gene	
Tail gene	
Fire gene	
Color 1 gene	
Color 2 gene	

16. You can select one of the four gametes from the mother and you will then see the border around it darken a bit. Click the arrow pointing to the right to move that gamete to the middle box.
17. Select one of the four gametes from the father and then click the arrow pointing to the left to move that gamete to the middle box.
18. Click "play" in the middle box to cause the gametes to fuse together. The result is a picture of the offspring that came about as a result of the fusion of those specific gametes.
19. Create a child dragon with wings, but no legs. To inherit these traits, the child will need to have the gene combinations *ww* and *ll*. Can the father provide his half of these combinations? Why or why not?
20. If we want to create a child dragon with the gene combinations *ww* and *ll*, can the mother carry through on her part of the bargain? Why or why not?
21. After answering this question, you are done with the activity.
22. Upload this modified document to the appropriate dropbox.

MICROEVOLUTION AS CHANGES IN ALLELE FREQUENCIES

For this lab you will need to buy, beg, borrow (but not steal) some beans. You will need two different colors, white and dark (brown, black). Use beans about navy bean size (no limas, etc). The beans of each color should be approximately of the same size. You'll need about 100 of each. Other than that, the lab is self explanatory. You will be comparing selection to genetic drift with regard to how each changes gene frequencies in a population. **MAKE SURE YOU MAKE YOUR PREDICTIONS AS TO THE OUTCOME BEFORE YOU START.** Having another person help you will make the lab go faster. The natural selection part takes longer to do than the genetic drift part. Have fun!

In this lab you will compare natural selection and genetic drift with regard to their ability to change the frequency of an allele in a population. You will use dried beans of two different colors to represent two alleles for a trait. One color (dark) will represent the dominant (B) allele and the other (white) will represent the recessive (b) allele. Make sure the beans are of approximately the same size.

In the first experiment, you will determine the effect of unequal selection on the frequency of the recessive (b) allele.

In the second experiment you will determine the effect of genetic drift on the frequency of the recessive (b) allele.

Please read the lab over carefully before you start. Make sure you make a prediction regarding what will happen to the frequency of the b allele for both experiments before you start. Your prediction should be of this nature:

"For the natural selection lab, I predict the frequency of the b allele will increase (decrease, fluctuate randomly, stay the same, decrease and be eliminated)."

UNEQUAL SELECTION

First Round:

In this experiment we will exaggerate the difference in selection against the two alleles.

B = dark

b = white

Each bean = one allele

Selection against the white phenotype (bb) = 90%

Selection against the dark phenotype (BB and Bb) = 50%

Obtain a small plastic bag with 50 white beans and 50 dark beans. These 100 beans represent your INITIAL GENE POOL. This is the gene pool that would be present if you mixed 25 homozygous dark (BB) and 25 homozygous white (bb) organisms together and allowed them to mate randomly.

1. Shake up the beans to simulate random mixing of the gametes during the first season of mating.
2. Reach into the bag, and (without looking) take out two beans: this is the first individual.
3. Set these beans aside and repeat the procedure 49 times until you have used up all of the beans. Arrange the BB, Bb, and bb genotypes in rows (one row of bb, one of BB, and one of Bb pairs) as you draw.
4. Select against the phenotypes by removing 50% of the BB genotype and 50% of the Bb genotype (predators can't tell the difference). Then remove 90% of the bb genotype. Round off the number of individuals to be removed to the nearest integer. For example, if you happen to calculate that 4.5 individuals should be removed flip a coin to decide whether to remove 4 or 5 individuals.
5. Count up the number of light and dark BEANS left and calculate the percentages of each.
6. Enter the results in Table 1 under Generation 1.

Second Round:

Begin the second round by replenishing your beans so you have 100 beans with the SAME percentages of light and dark alleles that you had after the FIRST ROUND. For example, if you ended up with 14 B alleles (brown beans) and 9 b alleles (white beans) after the first round, your calculated frequency would be 14/23 or .61 (61%) for the B allele and 9/23 or .39 (39%) for the b allele and your next round should start with a bag of beans with 61 brown and 39 white beans

7. Shake up the beans.
8. Select 50 individuals.
9. Remove 50% of the BB and Bb genotypes and 90% of the bb genotype.
10. Calculate the percentages of light and dark beans left and enter the results in the table under Second Generation.
11. REPEAT THIS PROCEDURE 3 MORE TIMES (total of 5 Rounds).

GENETIC DRIFT

Measure genetic drift in the following experiment without natural selection. In this experiment the survivors are determined by chance (survivors are the first ten pairs drawn) rather than as a result of selection.

First Round:

12. Put 50 light beans and 50 dark beans in a bag and shake it up to simulate mating.
13. Draw 10 pairs of beans from the bag to represent 10 individuals.
14. Count the light and dark beans and calculate the percentages. Enter your data in Table 2 under Generation 1.

Second Round:

15. Begin by replenishing your beans so that you have 100 beans in the percentages that you had at the end of the first round.
16. Mix the beans.
17. Draw 10 pairs of beans from the bag to represent 10 individuals.
18. Count the light and dark beans, calculate the percentages. Enter the results in Table 2 under Generation 2.
19. REPEAT THIS PROCEDURE 3 MORE TIMES (5 rounds).
20. Attach a picture of this final result with your face in the picture with the beans.

Natural Selection & Genetic Drift Lab Report

Name: _____

Date: _____

Section: _____

1. Compare your expected results with your actual results.

NATURAL SELECTION

Predicted:

Actual:

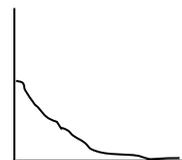
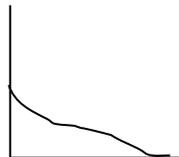
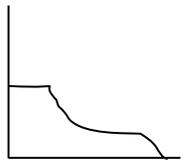
GENETIC DRIFT

Predicted:

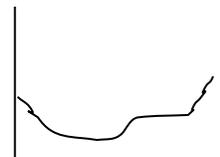
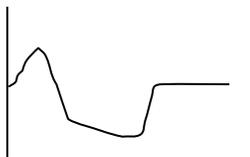
Actual:

2. Look at the results below of some of the other people. Did they differ from yours? Why?

NATURAL SELECTION



GENETIC DRIFT



3. What conclusions can you draw from this demonstration? Include a comparison of natural selection to genetic drift.

TABLE 1: FLUCTUATION IN FREQUENCY OF b ALLELE DUE TO INCREASED SELECTION AGAINST IT

B				b		
Rounds	#	%	Frequency	#	%	Frequency
Initial	50	50	.5	50	50	.5
Generation 1						
Generation 2						
Generation 3						
Generation 4						
Generation 5						

Graph your data below. Be sure to label the axes of your graph correctly!

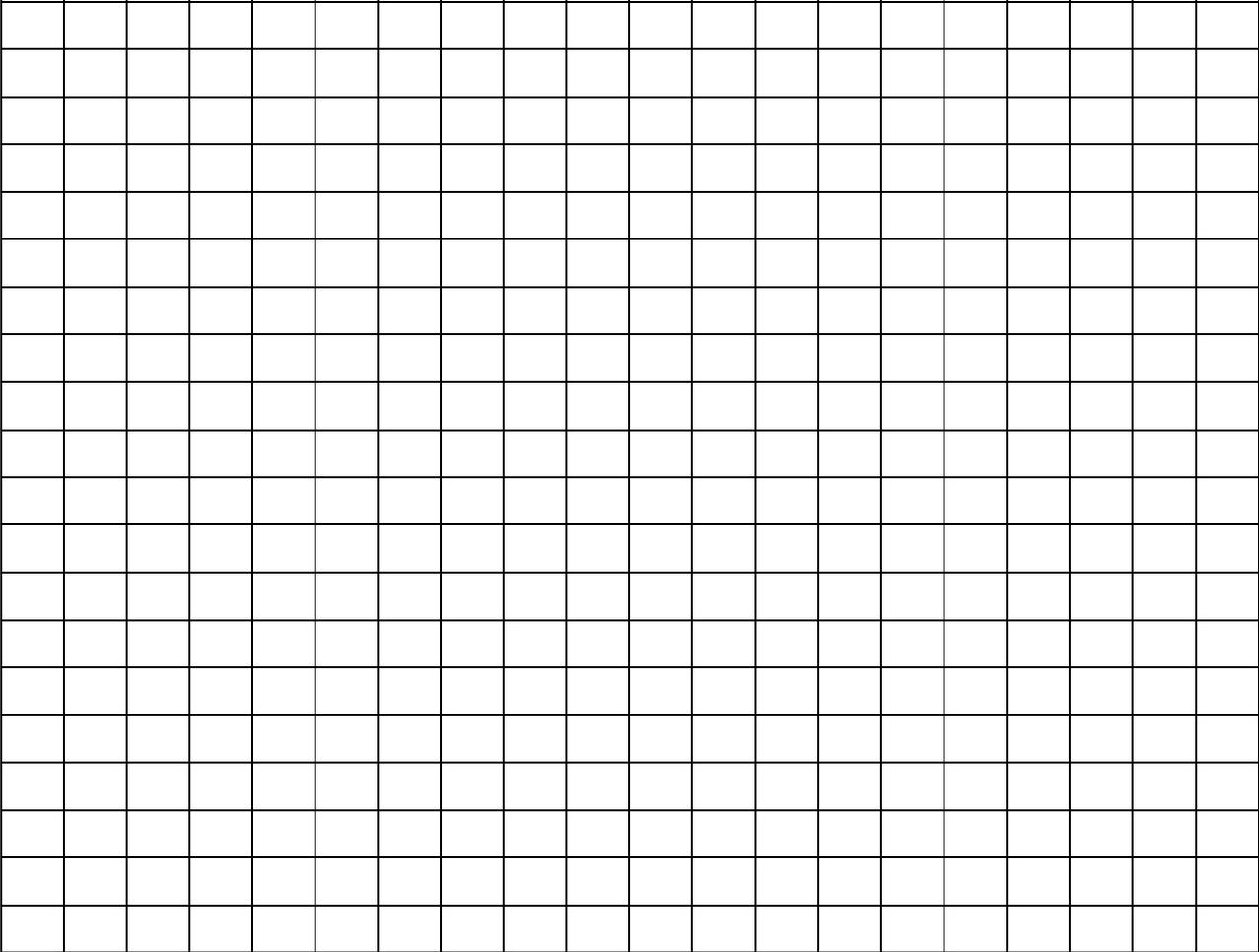
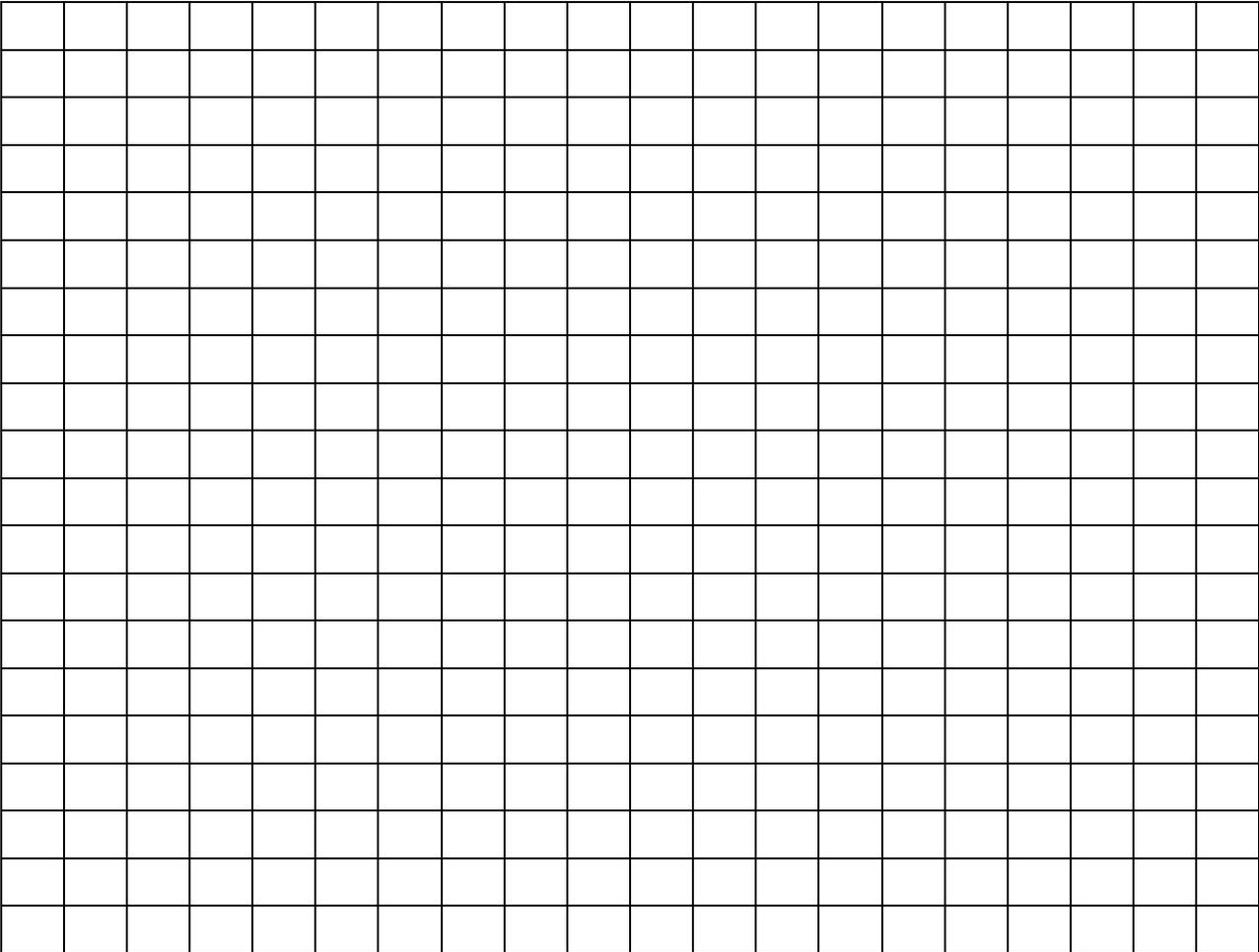


TABLE 2: FLUCTUATION IN FREQUENCY OF b ALLELE DUE TO GENETIC DRIFT

B				b		
Rounds	#	%	Frequency	#	%	Frequency
Initial	50	50	.5	50	50	.5
Generation 1						
Generation 2						
Generation 3						
Generation 4						
Generation 5						

Graph your data below. Be sure to label the axes of your graph correctly!



HUMAN EVOLUTION

Objectives:

1. To become familiar with some of the differences between human skulls and gorilla skulls.
2. To put into a chronological sequence a series of primate skulls based on evolutionary trends.
3. To learn to justify an evolutionary ranking by referring to features known by paleoanthropologists to be important.

Introduction:

The purpose of this lab is to put yourself in the shoes of **paleoanthropologists** as they make new discoveries and attempt to piece together the “jigsaw puzzle” of human evolution. Your instructor will begin the lab by comparing the features listed in lecture as they appear in a gorilla skull and a human skull. Then, keeping in mind these features as well as the evolutionary trends in human evolution (decreasing jaw and teeth size, increasing cranial capacity), put the 5 unknown skulls in order from most gorilla-like to most-humanlike.

1. First familiarize yourself with the major traits that are used to differentiate between the various hominin fossils that you will be observing in the lab today. These traits are located in the table in subsequent pages of this lab activity.
2. Your fossils can be observed at the following website:

<http://humanorigins.si.edu/evidence/3d-collection/fossil>

3. Direct your attention to the species dropdown box on the above website. This can be used to find the particular species that you will need to make observations upon. In this lab, use the following species to correlate with the following letter that the lab refers to.

A - *Australopithecus africanus*
B - *Homo erectus*
C - *Homo habilis*
D - *Homo neanderthalensis*
E - *Australopithecus afarensis*

4. Each of 5 “unknown” primate skull models is labeled with a letter (above) from A through E. In addition, you are given a gorilla skull as a “known” gorilla skull (in the dropdown box too) and a human skull as a “known” human skull (it’s in the dropdown box too). These two skulls are your two reference points.
5. Examine each unknown skull and assign a numerical value of 1 to 5 for each of the ten characteristics that distinguish gorilla and human. (See table “Comparisons of Gorilla and Human Skull Characteristics” below.) Just “eyeball” the skulls with regard to the distinguishing features and determine the

order of the skulls. You will, however, have to come back to the features to defend your rankings!

1 = most gorilla-like
5 = most human-like

6. Construct your own table that has all the traits along one side and the skull names or letters along the top.
7. Using only the characteristics given in lecture as a criteria (don't make up your own), rank the models from most primitive (gorilla-like) to least primitive (human-like).

Most gorilla-like (oldest) \longrightarrow Most human-like (youngest or most recent)

Your ranking: __, __, __, __, __.

8. Write a brief paragraph for **each** model explaining its characteristics and why you ranked it where you did.
9. Be sure to indicate in your paragraphs the ranking you decided on for the 5 unknown skulls. The order must be from most gorilla-like to most human-like.
10. With regard to the 5 short paragraphs for each skull, start with the most gorilla-like. You must include the following for each skull separately.
 - a. Tell where you placed the skull in the ranking.
 - b. Using only the features listed in the lab, describe at least **two** features of the skull that justify its ranking.
 - c. Describe those features in some detail (do not just say a feature is "human-like" or "gorilla-like").
 - d. Explain how those features compare to the same features in the previous skull (again, describe, do not simply refer to features as "more human-like" or "more gorilla-like") to make it less gorilla like. When describing your most gorilla-like skull, you should, of course, describe features that make it the most gorilla-like of all 5 unknown skulls.
11. Submit a document containing the table that you made along with the paragraph summary for each hominin skull.

Table 1: Comparisons of Gorilla and Human Skull Characteristics

Characteristic	Gorilla	Human
Face/Brain Ratio	large: face is large compared to braincase	small: face is small compared to braincase
Brow Ridges	prominent, large	very small, indistinct
Canines	extremely large	present but small, usually no larger than the other teeth
Location of Foramen magnum	toward back of skull, plane of foramen magnum is <u>not</u> parallel to ground	directly under skull, plane is parallel to ground
Profile Muzzle	muzzle sticks out from face	no muzzle, face is virtually flat
Chin	none present (does not stick out in profile)	present (sticks out in profile)
Shape of Dental Arcade	tooth row in lower jaw is U-shaped (molar rows parallel)	tooth row in lower jaw is parabolic:
Jaw Size	massive, robust, large	delicate, small